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ABSTRACT

This study investigates a model for teacher enhancement that incorporates cross-cultural interaction and the construction of web-based environmental teaching modules that would support sustained collaborative inquiry among students and teachers. Over a two-year period, web-assisted environmental inquiries and web-based teaching modules were developed to engage students in environmental inquiry and empowering them to take an active role in their communities. The model includes elements such as face-to-face collaboration among teacher-colleagues, hands-on experience for the teachers in data collection and analysis, seminars on advanced topics such as service learning, and ongoing university support. Results show teacher enhancement that not only engages teachers in new pedagogies and technologies, but also empowers them to develop curriculum for their students in a supportive, collaborative environment and may promote sustained Internet use. (KHR)

Impact of Global School/University Partnerships on Science Teacher Enhancement

[Jack Hassard
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IMPACT OF GLOBAL SCHOOL/UNIVERSITY PARTNERSHIPS ON SCIENCE TEACHER ENHANCEMENT

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Statement of the Problem

Telecommunications has had a profound impact on nearly all aspects of human communication. Whereas the Internet was once a forum used exclusively for data exchange among scientists, it has become a primary mode of communication for many ordinary citizens. We bank, we shop, we even make dinner dates with friends across town using personal and corporate home pages and e-mail. This past year one of our daughters conducted her college search and the application process almost exclusively via the Internet. Yet, despite the increasing extent to which direct Internet connections are available in schools (remember President Clinton's 1996 call to get every classroom on the Internet?), teachers have been slow to incorporate the Internet into classroom instruction (Fabos & Young, 1999). One national survey (Becker, 1998) reported that only 6% of teachers had their students collaborate over the Internet during the 1997-98 school year.

Since the early 1990's, we, along with several other groups, have been interested in using the Internet to support collaborative inquiry through the creation of virtual "scientific communities of practice": web sites, bulletin boards, and chat rooms through which students could collaborate with students in classrooms at a distance (in other parts of the US, or in other countries) in the collection and analysis of data related to common environmental problems and issues. We wrote and published a teachers' guide for implementing the Global Thinking Project (Hassard & Weisberg, 1999a), established a web site to support the project (www.gtp.org), and conducted several summer leadership institutes for teachers funded by the Eisenhower program

and the USIA. We have also organized three large-scale exchanges of student and teachers from Georgia and Russia within the context of the Global Thinking Project (Hassard & Weisberg, 1999c). Yet, like other such projects reviewed by Feldman, Konold & Coulter (2000), we have been disappointed that sustained collaborative inquiry has not been maintained between classrooms over time.

Feldman, Konold & Coulter (2000) suggest that network science projects have not realized their initial promise because the focus of these projects is misdirected and because teachers are not adequately prepared for facilitating inquiry-based lessons. According to these authors,

- The Internet should be used to broaden the context of locally grounded science inquiries.
- The teacher's classroom, not the online community, should be considered as the primary learning environment.
- Internet projects must provide multiple entry points for using technology to support curriculum activities, since teachers have diverse attitudes towards and competency with technology, and
- Internet resources (such as informational web sites) should be carefully chosen and integrated into lesson plans that guide students to the most productive use of the resources.

Even teachers who are comfortable using the Internet need to be comfortable participating in scientific inquiry themselves. They need opportunities to develop sufficient content knowledge to respond appropriately to questions and issues that arise during inquiry, and to develop basic skills in the collection, management and interpretation of data. Furthermore, these authors maintain, teachers need to develop these capabilities over time through face-to-face dialog with colleagues in a supportive community of practice.

Purpose

The purpose of the Eco-Connections project was to design a model for teacher enhancement that incorporates cross-cultural interaction and construction of web-based environmental teaching modules, and that would support sustained collaborative inquiry among students and teachers. Over a two-year period, teams of Russian and American teachers participated in summer workshops during which they conducted web-assisted environmental inquiries and designed web-based teaching modules aimed at engaging their students in environmental inquiry and empowering them to take an active role in their communities. The model includes elements such as face-to-face collaboration among teacher-colleagues, hands-on experience for the teachers in data collection and analysis, seminars on advanced topics such as service learning, and ongoing university support.

Background and Theoretical Perspectives

The design of Eco-Connections was based our previous experience with the Global Thinking Project (GTP), and was grounded in humanistic psychology, constructivism, technology education, and service learning. School/university partnerships have been an essential feature of the summer workshops, as well as of the implementation and evaluation of the curriculum materials generated. We begin our discussion with a brief examination of the Global Thinking Project.

Global Thinking Project

Our earlier project, the Global Thinking Project (Hassard and Weisberg, 1992; Hassard, Cross & Plant, 1994), began as an exchange of ideas among American and Russian teachers, teacher-educators, and psychologists about how students learn. A series of unofficial visits of American educators and psychologists to the Soviet Union between 1983 and 1988, sponsored

by the Association for Humanistic Psychology, formed the basis for the relationships from which the Global Thinking Project emerged (Hassard, 1990; Hassard, 1997). Acting out of their common concerns for the well-being of the planet and for improving relationships between the people of their two countries, faculty at Moscow Experimental Gymnasium N. 710 in Moscow, researchers at the Institute for General and Educational Psychology in Moscow and at the College of Education of Georgia State University in Atlanta, and classroom teachers in Georgia eventually agreed to develop collaboratively teaching materials and strategies that would:

1. Empower students and teachers to get involved with important global problems and concerns;
2. Introduce students to collaborative methods and strategies and inquiry that could be used to solve problems locally, and provide the knowledge and technological means need to deal with problems globally; and
3. Develop computer literacy in students that would allow them to use microcomputers as a telecommunications tool to collaborate with counterparts in other nations (Hassard, 1997).

This early collaboration evolved into the *Global Thinking Project* (GTP), a web-assisted environmental inquiry project, supported by a teacher's guide (Hassard & Weisberg, 1999a) and a web site (www.gtp.org), through which students and teachers explore local environmental issues and concerns within a cross-cultural context.

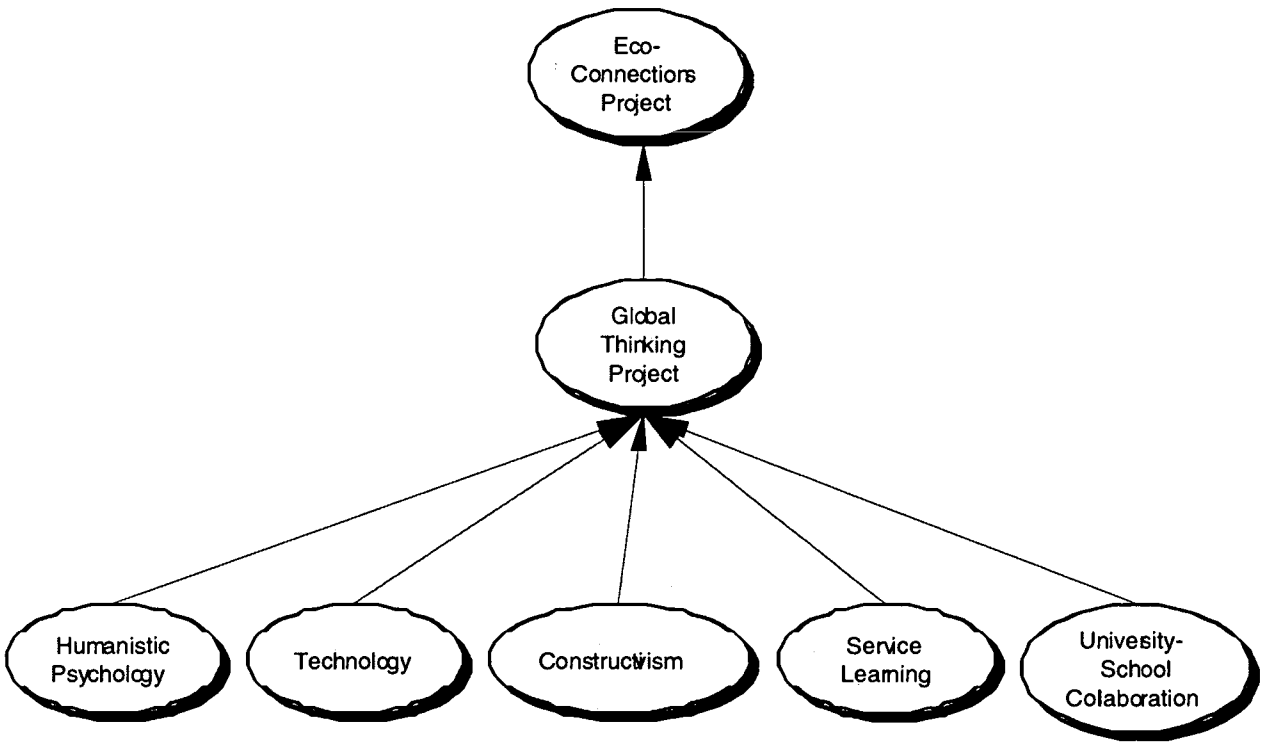

Figure 1: Theoretical Constructs Linking Global Thinking and Eco-Connections Projects

Humanistic Psychology

Our earliest discussions with our Soviet counterparts focused on the role of teachers in creating classroom environments that foster the exchange of ideas within a cross-cultural context. Discussions were held on approaches to creative teaching and the individual development of students, as well on significant social and political issues as nuclear weapons and women's issues. Science education, per se, was not central to our initial discussions. Based on these discussions, we developed the concept of "global thinking, " a concept grounded in a humanistic, rather than a traditional view of teaching and learning. As illustrated in Figure 2,

this involves a shift from mechanized, individualistic thinking grounded in an industrial model to thinking that is relativistic, interdependent, and cooperative.

Figure 2. The Paradigm Shift from the Traditional Model to a Humanistic Model

The Traditional Model	Humanistic Model
• Traditional, mechanized thinking • Individualistic--although students may at times work together in groups, interdependence typically is not a goal. • Dependence--teacher-directed instructional model establishes a dependent social system. • Hierarchical---choice-made-for-you. Rarely do students choose content or methodology for their investigations • Emphasis on literacy: knowing facts, skills, concepts • Emphasis on content; acquiring the right body of knowledge • Learning encourages recall, and is analytical and linear	• Innovative, flexible thinking • Cooperative--students work collaboratively in small teams to think and take action together • Interdependence--a synergic system is established in groups within a classroom, and within global communities of practice. • Right-to-choose---students are involved in choice-making including problem and topic selection, as well as solutions; reflects the action processes of grassroots organizations • A new literacy insofar as "knowledge" relates to human needs, the needs of the environment and the social needs of the earth's population and other living species • Emphasis on anticipation and participation; on inquiry, learning how to learn, and how to ask questions • Learning encourages creative thinking, and is holistic and intuitive

This paradigm shift has implications for classrooms and for curriculum in schools. In schools based on the traditional model, teaching and learning are organized around teaching students about specific disciplines. The new model suggests a different way of organizing courses, and experiences. Springer (1993) suggests that:

> Global thinking takes direction from societal concerns rather than from the inward structure of traditional education. Global thinking means looking at the process of schooling differently, considering what it means to be well educated in a global society. Global Thinking presents man as a constructivist, a social scientist capable of using a wide range of scientific attitude skills to develop theories for inventing the future and affecting change. Applying the anticipatory/participation

model, global thinking facilitates interactions, connections and partnerships that allow students to experience the social nature of knowledge. (Springer, p.79).

Springer sees global thinking as a means of helping students accommodate to the rapid globalization of the world by becoming aware of and acting on the themes of interdependence and right-to-choose. Interdependence requires action on the part of the student. Understanding interdependence must go beyond the definition, and be based on real work by the students. Providing experiences in which students learn about interconnections among global problems and among people is essential. Collaborating on cooperative projects with students in other cultures is one example of how to "teach" interdependence.

The "right-to-choose" metaphor has emerged around the world as people have demanded the right to participate in all aspects of their lives. Grassroots movements have had powerful impacts on how people think about change. As people have realized how powerful their images of reality are, they have demanded the right-to-choose. This notion has profound implications for decisions that are made about how and what to teach. Providing students with opportunities to enact their ideas to solve problems, indeed to select the problems they wish to investigate, is a hallmark of global thinking.

Constructivism

The underlying framework for the teacher enhancement program is social constructivism, the notion that learning is a process of active meaning-making in a supportive social context. In teacher education, many of us are incorporating this notion into our courses. Too often, however, professional enhancement for experienced teachers is still based on a positivist, banking model. We believe that like pre-service teacher education, effective learning experiences for professional development should include learning experiences that enable

practicing teachers to confront their tacit knowledge about teaching and learning and to build new understandings as they reflect together on common experiences.

This project called for cross-cultural teams of teachers to design web-based environmental science teaching modules based on an inquiry model. Not only were we asking the teachers in this project to learn how to use a new technology effectively, but we were also asking them to learn how to use an inquiry model in conjunction with the Internet. In practical terms we accepted the notion that the experienced teachers in this project had varying levels of familiarity with inquiry-based teaching and with using the Internet to support science instruction. Since we believe that learners construct new knowledge through direct experience, collaborative discourse and reflection, the summer workshops were designed using an experiential and active learning model to give the participants a common basis for discussions centered on pedagogical theory. The cross-cultural composition of the teams allowed participants to explore each others' unique perspectives regarding environmental problems and issues in each others' countries, and to incorporate their new understandings into topics in which their students would share a common interest.

Service Learning

Service learning is any learning experience in which students learn and develop through active participation in thoughtfully organized service experiences that meet actual community needs. Service learning experiences which are carefully integrated into the academic curriculum prepare students for living and actively participating in a democratic society, allow students to practice newly-acquired skills in an authentic context, and lead to an increased sense of social responsibility and caring for others (Wisenmeyer & Rubba, 1990; Dunkerly-Kolb, 1998). Our previous work has shown that when students engage in such real world collaboration with

citizens of other countries to address environmental problems of local concern, they develop enhanced global perspectives as well. (Dunkerly-Kolb & Hassard, 1997; Hassard & Weisberg, 1999b,c) In this project, participants attended a seminar on service learning and then actively incorporated principles of service learning into their web-based teaching modules.

Technology

The development of new technologies has fostered new ways of conceptualizing the teaching of science (Tinker, 1993). One area that received great attention during the 1990's was the use of telecommunications in science teaching to create technology-mediated communities of learning. Projects such as the National Geographic Society KidsNet (Weir, 1992), TERC's Labnet (Ruopp, 1993), and TERC's Global Laboratory (Global Laboratory Project, 1992) used telecomputing and team learning to establish communities of science learners. Since 1989, we have maintained a *Global Thinking Project Community of Practice*, which now includes more than 50 schools in 8 countries. Although the *GTP Community of Practice* began as an e-mail project, it now makes use of a full range of Internet resources including a web site (www.gtp.org), electronic bulletin boards, video conferencing, chat and the use of Internet forms to send and retrieve data.

Rather than seeing technology-mediated distance learning as a means of delivering content, we have designed a program that connects people (students, teachers, scientists) in the common enterprise of global thinking through the exploration of environmental problems and issues (Brunner, 1992). We are more interested in helping students ask questions, probe, and reflect about the environment rather than in delivering content to them. The project has conducted intensive Summer Leadership Institutes where teachers from around the world convene to learn about teaching global thinking, an academic-year implementation and support

program in which schools implement the curriculum of the Global Thinking Project (Hassard and Weisberg, 1999a), and an interactive website. Building on our previous work, we are working towards an ongoing global community of teachers and students who develop the knowledge, skills, affect and behavior to achieve environmental literacy.

While telecommunications can provide a structure for collaboration among teachers and students, teachers need experiences which will help them implement such complex projects (Ruopp, 1993). Very few teachers have had experience using telecommunications, and even fewer have integrated distance learning into science teaching (Hunter, 1992). To support the Global Thinking Project, we have maintained a sustained program of teacher education which not only provides the technical training teachers need to master telecommunications technology, but also provides ongoing support as they begin to engage their students in telecommunications-mediated collaborative inquiry projects. This support system was extended in the Eco-Connections project to include direct teacher-authorship of curriculum materials and focused university-based support for collaborating teacher-teams.

University/School Cross Cultural Partnership

Although Georgia State University has been the focal point for the collaboration among American and Russian educators over the past fifteen years, the work has been a partnership among schools, universities and research institutions on both sides. Because this work began without external funding, initial support for the project came from individual American teachers and professors. Over a period of five years (1983 - 1988), these American educators persisted by visiting the USSR each year and established connections with various Soviet institutions (Hassard, 1990). Chief among these connections was the relationship established with the USSR Academy of Pedagogical Sciences. Three years before receiving external funding on the

American side, the Soviets supported the financial cost of receiving Americans in Moscow and Leningrad, and provided air fare for the Russian educators that visited Georgia between 1988 and 1993 (Hassard, 1997).

Schools and universities have been conceived as equal partners in the work of both the Global Thinking Project and the Eco-Connections project. Both projects have brought educators from both sides together to develop curriculum, enhance each other's professional development, and promote collaboration. These collaborations have included teacher and student exchanges, summer leadership institutes for teachers, student environmental summits, and individual exchanges, as well as on-line collaboration (Hassard, 1997).

The Model: Eco-Connections

The Eco-Connections Project (www.eco-connections.org) is an international collaboration among teachers and administrators in Walker County, Georgia and St. Petersburg, Russia, Georgia State University (GSU), the State Pedagogical University of St. Petersburg, and the Hydrometerological University of St. Petersburg, Russia. The long range goal of the project is to produce a model of staff development and a telecommunications-based science curriculum that other school systems with Internet access will be able to replicate. During two successive summer workshops, Russian and American teachers collaboratively designed web-based teaching modules for middle and secondary school students. The interdisciplinary modules involve students in local and global scientific investigations, and help students develop the knowledge, skill and affective qualities to take responsible citizenship action on environmental issues. The instructional modules were published on the Internet through the Eco-Connections web site, and were field tested and evaluated by the teacher-authors during the 1999-2000 and

2000-2001 school years. The web site facilitated on-line collaboration among the teachers, their students and experts in the field.

Teacher Enhancement in the Eco-Connections Project

A grant from the Georgia Department of Education supported bringing together four cross-cultural teams of approximately five teachers for summer workshops in 1999 and 2000. In July, 1999, these teachers participated in a teacher enhancement and curriculum development institutes in Chickamauga, Georgia. In order to enhance their knowledge and skill about environmental science and web-based teaching, teachers conducted hands-on scientific investigations and used the Internet and other technologies to analyze and communicate ideas about environmental science topics. They also had extensive training on developing web pages, using the web to find resources on environmental science, and using the web as a tool to enhance student learning in their own classrooms. Finally, each team created one teaching module, consisting of several web-based lessons based on a constructivist model of learning. . During the academic year 1999 - 2000 each teacher team implemented the module they developed, as well as one other module. Teacher-teams collaborated during the implementation phase using Internet chat sessions, on-line bulletin board discussions, and video conferences. Local evaluation sessions were organized by the university partners during spring, 2000. The teacher teams met again in St. Petersburg, Russia in June, 2000, to assess their work and to develop a second set of modules to be field tested during the 2000-2001 academic year.

A detailed work plan for the project is shown in Figure 3.

Figure 3: Eco-Connections Work Plan, 1999 - 2001

Date	Development/Implementation Activities
May, 1999	Initial meeting among American teachers in Walker County, and Russian teachers in St. Petersburg Focus: Introduce Internet communication tools (email, e-group, bulletin board and chat rooms); organize several communication activities from May – July in which American and Russian teachers use the Net tools to discuss issues and develop an "Internet Habit of Mind."
July 8 – July 20, 1999	Summer Institute I and Staff Development Program---in Georgia Focus: Development of the first set of web-based modules for secondary students with a focus on social responsibility. Themes: a) Using the tools of Internet to enhance communication and research; b) Enhancing teachers knowledge of environmental science; c) Understanding how to use low and high technology tools to explore the environment; d) Integrating these themes to develop Web-based modules.
September – December, 1999	Pilot Testing, Phase I Teachers in each Walker County, GA and St. Petersburg, Russia pilot test modules in their classrooms. Each module tested in at least four classrooms (two American and two Russian).
	Pilot Testing Center Meetings and Evaluation Data American and Russian teachers meet under the leadership of project staff to discuss issues and problems related to the pilot testing of the web-based modules. Evaluation data collected.
March – May, 2000	Pilot Testing, Phase II The two remaining modules pilot tested in at least four classrooms. Pilot test center meetings continue and evaluation data continues to be collected.
June, 2000	Summer Institute II and Staff Development Program---in Russia Focus: Evaluation of the Web-based Modules, and the Development of additional Web-Based Modules.
September – December, 2000	Pilot Testing, Phase III Two modules pilot tested, each in at least four classrooms (two American and two Russian).
January – April, 2001	Pilot Testing, Phase IV Two remaining modules pilot tested in at least four classrooms. Pilot test center meetings continue and evaluation data continues to be collected.
May – July, 2001	Evaluation of Implementation Program Project staff will use teacher evaluation data to finalize the web-based modules.
July - September, 2001	Final Evaluation and Report

Results

The Eco-Connections project has

- helped teachers develop the skills to author and carry out web-based activities that engage students in problem solving and action taking with respect to environmental science.
- produced teacher-created content based modules that can be used in different cultures to help students understand their own local environments.
- provided teachers and students with a new set of communication tools utilizing the Internet, including e-mail, electronic bulletin boards, chat rooms, web-based forms to post and retrieve data, and video conferencing.
- contributed to better cross-cultural understanding of by allowing teachers and students to work closely with peers from a different culture,
- made use of a website to facilitate cross-cultural collaboration, and
- addressed values such as caring, honesty, fairness, responsibility and respect for self and others through service learning projects in students' local communities.

The Eco-Connections Project has reached over 1000 students, teachers, parents, and community members by establishing a unique virtual community. The project is impacting the way in which students and teachers in different cultures are working together not only to educate and to inform, but also to empower action-taking on important environmental problems.

Tatiana Gurieva, one of the Russian teachers of the Eco-Connections Project put it this way:

> It is a very important project as it makes connections between people in the World. Also, students see how their decisions can be put in the Internet and how they can be read by other people. It will encourage them in the future for doing things influencing the world. Today it is very important to know how man can influence nature and how we can keep our world from destruction.

The project enables teachers, who for generations were isolated from other classrooms and colleagues, to use the tools of the Internet to link their students and themselves with others who share a common interest in taking responsibility for making the environment safer and more sustainable. These teachers have had a concrete experience using technology that positively benefits their students and their communities. Furthermore, they have worked as professionals at very high levels of performance; as authors of the curriculum as well as implementers, they take their work seriously, and are constantly looking for ways to improve their work. Sandy Weathers, an American teacher commented,

> Kim (my partner at school) and I were constantly comparing data gathering techniques as well as the data that was collected. We discussed ways to improve the labs, what was working and what was not working, things we would like to add to or delete from the module, and the Russian communications. We posted data daily and checked the data from the Russian teams and from the other Americans. I have been communicating with one of my Russian partners about the paper she has written about the project. She says she will send me a copy (hopefully it will be translated!), and she sent the address of the Russian site to which she submitted her paper. I also talked with other American partners several times during the project. We discussed how the other module was going timelines, and communications with the Russians.

For educators like Sandy Weathers and her colleagues in America and Russia, this direct engagement in and responsibility for curriculum development represents a new way of thinking about their professional work. The richness of being involved in cross cultural professional development seminars (the Summer Institutes), implementing global environmental science modules they authored, and being responsible for evaluating and changing the telecommunications curriculum has led to an enhanced view of the role of teachers in curriculum planning and development.

For students, the project has brought equally important benefits. Because the Eco-connections curriculum was implemented within the regular curriculum, students have been

shown how using technology can enlarge their view of content (science, mathematics, social studies and language arts), as well as the world. For the students, communicating with peers in another distant culture provided a sense of inquiry that was new to their experience. Even though many of the students had previous experiences "surfing the Internet", the idea of actually communicating with students in another culture was novel. Jose Jimenez, one of the American teachers noted that, "The students checked the bulletin board every day for messages and gladly posted their results in order to compare with the other participants. The students even enjoyed reading each other's messages."

A group of students in St. Petersburg, Russia reported,

> "We were online in Internet once a week. We read the letters of our peers from Georgia and when we had enough time we tried to answer them. During our work we researched issues about environmental problems and tried to find information on INTERNET in Russian. We put some of our results on the page of our school. It was very interesting to work with INTERNET, and we find skills of such experience very important and useful.

But it was not simply the idea of communicating with peers that was of benefit to the students. The students also experienced an enhanced sense of ecological responsibility:

> We've got better insight into the problems of ecology connected with acid rains. We began to pay attention on these questions in other subjects in school and certainly we feel a better understanding of these concepts now. We are conscious now about it. We are looking for the ways to combat with countered problems.

The Eco-Connections Project has developed a curriculum that benefits not only the teachers, students, and parents that have participated in its development, but every other school around the globe that wishes to utilize the project's resources.

Challenges

Eco-Connections is in its formative stage and faces many challenges similar to those faced by other network science projects.

Access to the Internet within their own classrooms is a significant obstacle for teachers. The project leaders worked with each American and Russian school to ensure that at least one computer with a connection to the Internet was available for the pilot classes. On the Russian side, access to the Internet for some schools was difficult; Internet access was via a dial-up modem connection, resulting in slow access speed. Furthermore, most of the Russian schools had only one computer with Internet access. The project provided funding to support Internet connectivity for each Russian school for the duration of the project.

Access to hands-on materials was also an issue for the Russian teachers. In several instances we had problems simply mailing teaching materials to Russia. Russian Customs officials assessed very large fees for these incoming materials. Our solution was to wire the funds to Russia, and have the Russians purchase the materials locally. For items not available there, we had to plan ahead and send project materials with travelers to Russia.

Another challenge for the leadership team was working with the teachers on the pedagogy that underlies project-based teaching. Project-based learning is by its nature inquiry oriented. Teachers must know how to support student inquiry by encouraging questioning, helping students understand how to monitor and collect data, and extending students' understanding through analysis and interpretation of data. The project facilitated discussions among the American and Russian teachers in an online environment using chat rooms and e-mail discussions, at local meetings during Phases I and II of implementation, and during the Summer Institutes of 1999 and 2000.

Another major difficulty was that of language. This barrier existed in face-to-face meetings at the teacher institutes, but also on the Internet, especially in bulletin board communication. A number of the Russian teachers and educators spoke English, and this was

essential at the summer institutes. The initial website (www.eco-connections.org) was designed in English, but a Russian Mirror was established at the Herzen State Pedagogical University Server (www.emissia.spb.su/wcrip/us/wcrip.htm/).

Finally, time was also a major difficulty that the project had to overcome. Teachers whose teaching calendars were already filled worked hard to find time to integrate the modules into their ongoing curriculum.

Summary

Educators in Georgia have demonstrated, through collaboration with educators not only in Russia, but other countries including Australia, the Czech Republic, and Spain that telecommunications can be used to engage students and teachers in network science activities. However, our experiences support the finding of others that without an inquiry-oriented classroom that puts the emphasis on local environmental research, telecommunications activities may not result in the meeting the goals of the projects.

Teacher enhancement that not only engages teachers in new pedagogies and technologies, but also empowers them to develop curriculum for their students in a supportive, collaborative environment, may promote the type of sustained Internet use we seek.

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